Panoramic*

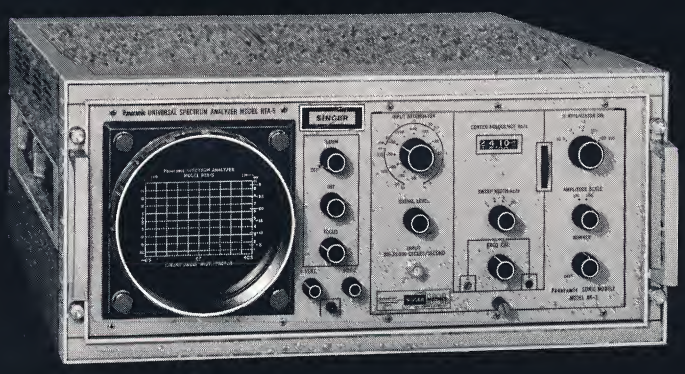
CATALOG SHEET TA-2/RTA-5

UNIVERSAL SPECTRUM ANALYZER 20 cps-27.5 mc

PORTABLE MODEL TA-2 • RACK-MOUNT MODEL RTA-5 • INTERCHANGEABLE PLUG-IN MODULES

MODULE	FREQUENCY RANGE
AR-1	20 - 35,000 cps
AL-2	20 - 35,000 cps plus log scan
UR-3	100 cps - 700 kc
VR-4	1 kc-27.5 mc

PORTABLE MAIN FRAME MODEL TA-2
WITH UR-3 MODULE



RACK-MOUNT STYLE MODEL RTA-5 WITH AR-1 MODULE
ALSO AVAILABLE IN COMPACT CABINET AS SHOWN

APPLICATIONS

- Monitoring audio, base band, and multiplexed signals in communications systems.
- Rapid measurement of telephone carrier channel equalization; measuring slope, bulge, twist. Noise, distortion, and other troubles are seen and measured.
- Vibration, noise, and acoustic analysis; on-site or in-plant.
- Harmonic and intermodulation distortion measurements.
- Telemetry subcarrier analysis; measuring channel pre-emphasis, crosstalk, and VCO deviation measurement.
- VLF, video, and RF band measurements.
- Noise density vs frequency plotting .

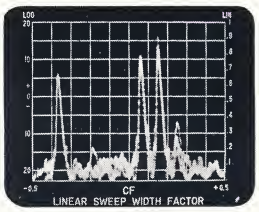


FIG. 1A Motor vibration on 0 - 5 kc sweep. Resonant frequencies and amplitudes are easily read (log amplitude). Narrow band scans provide greater resolution and accuracy.

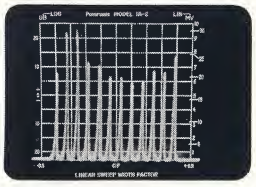


Fig. 1B UR-3 module measures levels of multiplexed carrier group on an operating telephone trunk line. Scan revealed that slope of carrier levels was out of tolerance and equalization adjustment of transmission circuit was needed.

FEATURES

- Rapid, quantitative swept band analysis of levels vs. frequency.
- The portable TA-2, rack mount RTA-5 main frames and the plug-in modules for sonic through R-F measurements are interchangeable for maximum versatility.
- The TA-2 operates from internal rechargeable or external batteries, and from AC lines.
- Simple to use. Well suited for maintenance and production applications.
- Directly calibrated displays and digital frequency readout provide simple, foolproof operation.
- Ruggedized construction; suited for field use. 0 to 55° C operating range.
- Highest quality, conservatively rated solid state components circuit card modular construction.
- Self-checking with crystal controlled picket fence markers.
- Provisions for standard Polaroid oscilloscope cameras with both the portable TA-2 and rack mount RTA-5 main frames.

GENERAL DESCRIPTION

The *Panoramic* Universal Spectrum Analyzers consist of a portable TA-2 or rack mount RTA-5 display main frames and interchangeable plug-in spectrum analyzer modules. Four versatile solid state modules are described in this bulletin for applications from 20 cps to 27.5 mc. The modules include the scanning and selectivity circuits and the level and frequency operating controls. Center Frequency and Sweep Width controls are digital and directly calibrated. Crystal-controlled markers can be switched on to check the frequency calibrations.

PORTABLE TA-2 MAIN FRAME

The solid state portable TA-2 display frame operates from internal or external batteries. It also can be powered from any AC line, 95-130/190-260 volts, 50-1000 cps. The internal battery pack is recharged automatically when the set is plugged into an AC line. Terminals on the rear of the TA-2 permit operation from DC power sources, 12 to 28 volts, DC. For extended battery operation, external battery packs and chargers are available.

The complete analyzer, TA-2, module and internal battery pack weighs 40 pounds. Form factor and weight distribution are designed to facilitate easy portability.

The TA-2 measures $9\frac{1}{8}$″ w x $12\frac{1}{8}$″ h x $18\frac{7}{8}$″ d. A reusable transit case #140-0003-001 for the TA-2 is available (See Photograph Page 4).

With minimum space, installation, power, setup, and adjustment requirements, the portable TA-2 can be used almost anywhere. Application areas for the TA-2 include laboratories, field stations, communications sites, production lines, and aboard vehicles. The easy portability of the TA-2 brings the time-saving of graphic swept band analysis to areas where size and weight limitations formerly required use of tedious point-by-point testing.

The conservatively rated PCB solid state design provides ruggedness, exceptional display stability and minimizing of warm-up problems. Narrow-band scans are precisely repeatable. Spurious responses due to power line hum are virtually eliminated. The TA-2 is always ready for use even after rough field handling. The operating temperature range is from 0° to 55° C ambient.

The upper right-hand section of the TA-2 main frame contains a slide out storage compartment. Accessory modules will fit into this space. The compartment is normally used to hold circuit card extender cables and other furnished accessories.

The TA-2 display provides bright, sharply-focused traces with high persistence. The high degree of visual retention provides easy appreciation of the overall display. Nearly the entire area of the flat-face $3\frac{1}{2}$″ square CRT is used, giving almost the same calibrated display area as a 5″ D, circular CRT. The illuminated calibrated graticule is engraved on the reverse side for minimum parallax.

For permanent records of the traces, a camera mount adapter, Model CM-2, is available for use with the portable TA-2 main frame. The CM-2 is easily attached over the CRT of the TA-2 permitting screen photos to be taken with the Model GA-200 oscilloscope camera. Auxiliary X and Y axis outputs for slave indicators and a trigger pulse output are furnished with both the TA-2 and RTA-5 main frames.

RACK OR CABINET MOUNTABLE RTA-5 MAIN FRAME

The RTA-5 main frame accommodates the same solid state plug-in modules as the TA-2. It requires only 7 inches of panel height in standard 19″ rack cabinets. Slides or a convenient bench mounting cabinet are optional.

The RTA-5 spectrum displays are traced on a 5″ high-persistence CRT with standard camera mounting bezel. The large calibrated graticule is adjustably illuminated. RTA-5 displays are large and exceptionally bright, for comfortable normal viewing. An image expanding viewer, Model PV-1, is available for applications requiring viewing at greater distances or for extended periods of time.

The RTA-5 operates from 95-130 or 190-250 volt, 50-400 cps power lines.

The interchangeability of TA-2 and RTA-5 with their plug-in modules minimizes duplication in assignment of units between field and in-plant tasks.

OBTAINING BEST RESOLUTION FROM A PANORAMIC SPECTRUM ANALYZER

Resolution is a measure of spectrum analyzer selectivity. It is the analyzer's capability to measure closely spaced frequencies. Resolution is defined quantitatively as the minimum frequency difference between two equal amplitude signals when their (pip) indications intersect 3 db (30%) down from their peaks (See Figure 5). The best obtainable (minimum value) resolution with discrete signals depends upon the sweep width and sweep rate, the

Resolution, $R \approx 1.5\sqrt{\text{Sweep Width} \times \text{Sweep Rate}}$ (for linear scans)
Where: R = Optimum (minimum) Resolution (cps)
Sweep Width (cps) = Total frequency excursion of scan
Sweep Rate (cps) = Scan repetition rate

To achieve this optimum resolution, the I-F bandwidth must be set somewhat less numerically than the resolution. The difference between the I-F bandwidth and optimum resolution is due to the difference between "static and dynamic" bandwidths. If the I-F bandwidth is set too narrow, excessive ringing, attenuation of the pip, and excessive pip width are observed. If the I-F bandwidth is too great, the observed resolution is limited by the actual I-F bandwidth and is poorer (larger) than "optimum".

In practice, the operator of a *Panoramic* Spectrum Analyzer need not make these calculations. On some instruments, the selectivity is preset with the sweep width control. For example, the resolution of the AR-1 and AL-2 Sonic Modules is optimized at any selected sweep width. On the UR-3 and VR-4 modules, the operator adjusts the I-F Bandwidth control for best visual resolution at any desired settings of Sweep Width and Sweep Rate.

With several closely spaced signals, setting the analyzer for minimum intersection of adjacent pips is readily made. (See Figures 2, 3 and 4.) Slower scans and reduced sweep widths permit fine resolution to be obtained. Please refer to Page 6, Specifications Section, for the detailed resolution capabilities of each module.

The AL-2 Sonic Module includes a preset logarithmic scan from 25 cps to 25 kc. The instantaneous frequency scanning rate varies during the log scan. Reduced scan speed at the lower frequencies allows finer resolution at that portion of the scan. To maintain optimum resolution, the proper I-F bandwidth value is automatically tracked throughout the log frequency scan by voltage control of the variable Q crystal filters.

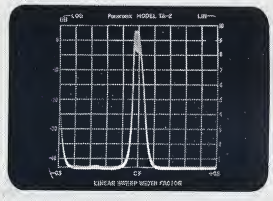


Fig. 2. Two closely spaced signals on TA-2 with UR-3 Ultrasonic module. At 25 kc sweep width and wide I-F band width signals appear as one pip.

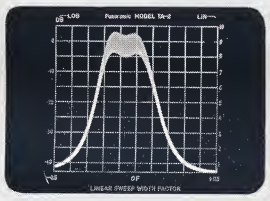


Fig. 3. Same signals as Fig. 2 with sweep width reduced to 5 kc.

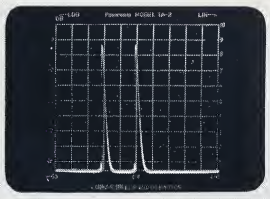


Fig. 4. Same signals at 5 kc sweep width and minimum I-F bandwidth are clearly shown to be separated by more than 1 kc. (Actual signals were at 8 and 9.1 kc).

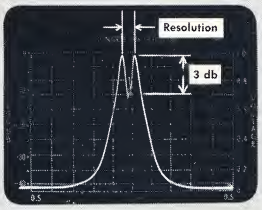
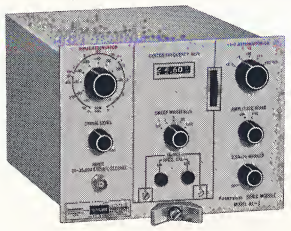


Fig. 5. Definition of resolution. Two equal amplitude signals, spaced so that their pips intersect 3 db down from their peaks.

AR-1 / AL-2 SONIC MODULES



20 cps - 35 kc

The AR-1 and AL-2 Sonic Modules are used for applications in the 20-35,000 cps frequency band. The AR-1 and AL-2 are calibrated in absolute values in both frequency and level. They are true swept band frequency selective voltmeters, reading in volts and dbm. A major application is in the field of swept band vibration measurements; in-plant or in the field. Other important uses include voice frequency circuit testing, digital and other pulsed signal analysis, harmonic and IM distortion measurements, dynamic analysis of speech and music, geophysical, medical, and process studies. Design of the AR-1 and AL-2 Sonic Modules incorporates many of the advantages of the widely used *Panoramic* Model LP-1aZ Sonic Spectrum Analyzer.

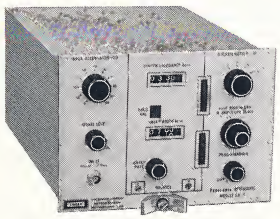
The Model LP-1aZ and the highly selective SY-Systems (including the LP-1aZ) are recommended for precise analysis of random data and spectral density plotting. Please refer to Catalog Sheet LP-1aZ.

The digital center-frequency control of the AR-1 and AL-2 is calibrated on the equivalent of six feet of dial length. Adjustment and reset capability are precise. Accuracy of reading ±1%, ±50 cps. Four linear sweep widths are switch selectable; 200, 1000, 5000, and 20,000 cps. The AL-2 also provides a preset 25-25,000 cps quick-look log scan. The AL-2 log scan calibration is directly calibrated on the graticule. It displays the entire sonic spectrum at a glance, pinpointing significant energies and saving time in setting up detailed narrow-band measurements. By reducing the scan velocity in the low-frequency region of the log scan, optimum selectivity is maintained, proportionately finer resolution at the lower sonic frequencies is obtained. The adjustable linear scans of the AR-1 and AL-2 are used for highly resolved observation of selected spectrum segments. Adjacent signals separated by 35 cps can be resolved on the 200 cps sweep widths.

An adjustable-level internal 2.5 kc oscillator frequency and its harmonics provide marker pips at 2.5 kc intervals. This marker oscillator is crystal-controlled with 0.02% accuracy. In addition, the "zero-frequency" pip resulting from the local oscillator serves as a convenient low-end reference point. The internal marker maximum amplitude is preset to provide a vertical (amplitude) calibration reference.

Full scale deflection sensitivity is 30 μv for the linear amplitude scale. Direct readout in dbm re: 600 ohms is also calibrated on the AR-1 and AL-2 modules. (−70 dbm, re: 600 ohms, is equivalent to 31.62 μv.) Signal levels as small as 3 microvolts are readily measured. Response flatness is ±0.5 db to 25 kc. Hum, harmonics, inter-modulation distortion, and other unwanted products are at least 60 db down.

UR-3 ULTRASONIC MODULE



100 cps - 700 kc

The UR-3 ultrasonic module covers the 100 cps - 700 kc sonic, ultrasonic, and low rf range and is useful for telephone carrier band monitoring and rapid slope equalization determinations. Other applications are analysis of telemetry subcarriers, VLF, other base band communications, sonar, and ultrasonic signals.

The 3-digit counter center-frequency readout on the UR-3 is equivalent to 12 feet of dial length. Precision of adjustment and reset capability are exceptional. Frequency accuracy is ±1%, ±1 kc. The UR-3 Sweep Width control is continuously adjustable from 1 to 400 kc. Readout is on a digital counter; accuracy is ±5% above 2 kc sweep width. This combination provides unprecedented ease of use. The spectrum segment under observation on CRT can be read instantly. The wide maximum sweep width of 400 kc enables broad sonic, ultrasonic and low rf bands to be monitored at a glance. Resolution of 100 cps is obtained on narrow-band scans. The selectivity (I-F Bandwidth) is adjustable from 100 cps to 4 kc. Scan rates are adjustable from 1 to 60 cps.

A crystal-controlled internal marker oscillator provides pips every 25 kc across the band for quick checks of frequency settings to an accuracy of ±0.1%. The "zero-frequency" pip also provides a useful reference point.

UR-3 sensitivity is 30 μv full scale linear. Signals below 3 μv are readily measured on the UR-3. Response uniformity is ±0.5 db up to 500 kc. Hum, harmonics, intermodulation distortion, and other undesirable products are at least 60 db down. A smoothing filter, useful in plotting noise spectra, and a manual scan control, for fixed tuning at any point in the scan range, are optional.

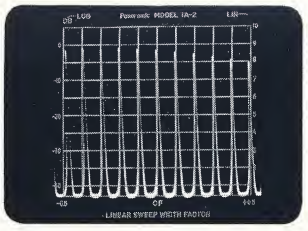
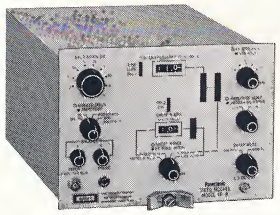


Fig. 6. Self-checking display on TA-2. Internal crystal-controlled markers on UR-3 display marker pips at 25 kc intervals. Sweep width is approximately 250 kc. Note excellent scan linearity.

NEW VR-4 VIDEO MODULE



1 kc - 27.5 mc
(Available 1966)

The VR-4 module provides rapid broadband scans and precise, high selectivity narrow-band displays. Scans are readily selected in the 1 kc to 27.5 mc frequency range. The response uniformity of the VR-4 is ±1 db up to 25 mc. Its unequalled versatility and swept band convenience make the VR-4 invaluable for a wide variety of communications signal tests. In telephone systems, the VR-4 enables instantaneous detection and measurement of high levels or other troubles on groups of message channels. The VR-4 is also well suited for noise signal analysis, video measurements, RFI and ECM spectrum monitoring, telemetry subcarrier analysis, and other critical tests.

Center frequency and sweep width controls have digital readouts for maximum convenience. Three sweep width modes are furnished. The preset 0 - 25 mc wideband scan, with automatic optimum resolution, is ideal for overall spectrum monitoring. On adjustable scans, the sweep width is adjustable from 50 kc to 5 mc with a digital readout control. The VR-4 display may be centered anywhere in the band of 0 to 25 mc. A 3-digit Center Frequency control counter is accurate to ±5%, ±5 kc.

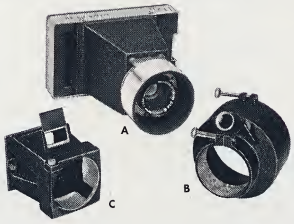
A unique locked local oscillator circuit provides jitter-free narrow-band analysis. On the narrow band mode, widths are adjustable from 500 cps to 50 kc. Signals as close together as 200 cps are readily resolved in narrow band scans. The I-F bandwidth is adjustable up to 20 kc to maintain proper selectivity at sweep widths.

The VR-4 provides crystal-controlled marker signals at intervals of 25 kc, 500 kc, and 5 mc. Their harmonics provide easily interpreted frequency references up to 27.5 mc. Precise narrow-band frequency calibrations are made by use of the 25 kc oscillator to generate sidebands on the other marker frequencies.

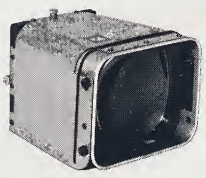
Sensitivity is 30 μv full scale, linear. Residual distortion is more than 50 db down. The VR-4 includes a video smoothing filter control for single line display of random signal spectra. A manual scan control for stable, fixed frequency monitoring anywhere within the normal scanned band is also furnished.

For frequency response plotting up to 15 mc, the VR-4 is operable with the Model G-6 *Panoramic* Companion Sweep Generator (slightly modified). Details upon request.

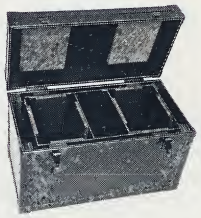
MODEL TA-2/RTA-5 ACCESSORIES



GA-200 Polaroid Oscilloscope Camera (A) is furnished with standard bezel adapter (B) for RTA-5 and other 5" CRT displays. CM-2 adapter (C) for TA-2 Main Frame, optional. The GA-200 provides full size non-inverted, screen photos (photos develop in 10 seconds).

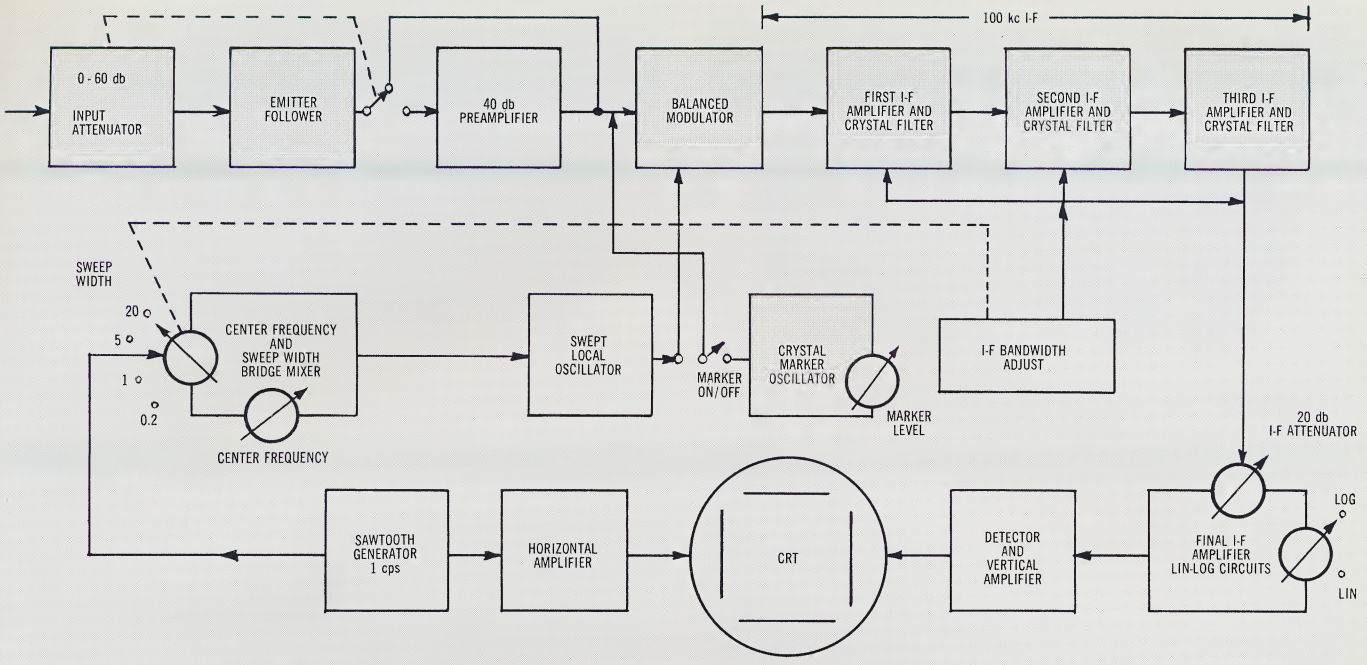


PV-1 image magnifying viewer, mounts on RTA-5 bezel for distortion-free viewing of screen at a distance.



Spare snap-in battery pack modules for TA-2. External charger for spare packs, to recharge extra battery packs while one is in use.

Reusable transit case for TA-2 (Part #140-0003-001).



Block Diagram of Typical Plug-in Module (AR-1)

BLOCK DIAGRAM DESCRIPTION

The TA-2 and RTA-5 and their modules are *Panoramic* Spectrum Analyzers displaying level vs frequency of input signals. They are scanning superheterodyne receivers which automatically and repetitively tune through a selected frequency band. Level is displayed as vertical deflections on a calibrated cathode ray tube presentation. Frequency is calibrated on the CRT horizontal axis. Horizontal sweep on the CRT is related to frequency sweep excursion of the analyzer, the horizontal deflection and the local oscillator are driven by the same sawtooth generator. Thus a calibrated visual indication of input frequencies is obtained.

A simplified block diagram of TA-2 with a typical module, the AR-1, is shown above. The input signal goes to an 11-position attenuator switch; adjustable from 0 to 60 db attenuation in 10 db steps; plus a 40 db gain preamplifier. The preamplifier is selected when needed by the attenuator control to provide an additional 40 db input sensitivity.

A sawtooth generator frequency modulates the voltage controlled local oscillator, causing it to scan the selected spectrum segment. The stability and residual F-M of the local oscillator in each module is consistent with the unit's resolution capability. Annoying jitter, hum sidebands, and scan-to-scan drifts are minimized. In addition to high-inherent stability, the modules' local oscillators are each capable of wide voltage controlled deviation. Excellent scan linearity enables accurate readings of frequency differences on the CRT display. The local oscillator frequency excursions are set by the calibrated center frequency and sweep width control settings. At any instant, the local oscillator is at a frequency equal to the (tuned in frequency + I-F). The CRT graticule is marked in 10% increments of sweep width. A summing bridge minimizes interaction between the sweep width and center frequency control voltages.

The signal from the swept local oscillator combines with the input signals in a high-stability diode ring modulator. A balanced modulator is used to enable reduction of the local oscillator injection into the I-F during low frequency tests, where the local oscillator frequency approaches the I-F. The balanced modulator also greatly reduces mixer nonlinear distortion, thus extending the analyzer's spurious-free dynamic range. Front panel balance controls are used when needed to reduce the level of the local oscillator pip, corresponding to zero input frequency. This adjustment is seldom required because of the stability of the modulator. A residual zero frequency pip deflection is used as a frequency marker.

The swept local oscillator mixes with input frequencies in the balanced modulator to produce differing frequencies equal to the I-F. The selectivity of the I-F amplifier provides the required ability to resolve individual input frequencies.

The I-F section of the AR-1 module consists of three 100 kc variable bandwidth crystal filters as shown in the block diagram. The bandwidth of each filter is varied automatically to maintain optimum resolution for each sweep width.

A precise 0 to 20 db I-F attenuator is used to adjust display levels. Following the narrow-band I-F stages, a linear detector demodulates the high frequency I-F output signals into low frequency envelopes or "pips" for display. The detector circuit contains a log compressing amplifier which can be switched in to display a 100:1, 40 db range with excellent deflection linearity. The linear and db scales are calibrated directly on the CRT graticule.

Each module has internal calibrated crystal-controlled oscillators to produce evenly-spaced markers (fundamental and harmonics) to accurately check sweep width and center frequency calibrations. The markers on the AR-1 module are spaced at 2.5 kc intervals. Marker levels can be adjusted independent of signal deflections.

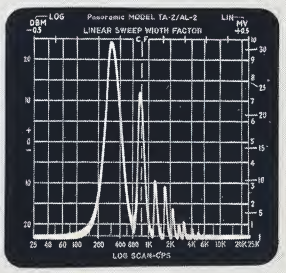
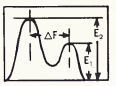


FIG. 7 — Harmonic analysis of 350 cps distorted signal using the preset log scan of the AL-2 Sonic Module. Linear amplitude scale used.

SPECIFICATIONS

MAIN FRAMES	TA-2	RTA-5
CRT Indicator (P7 high persistence phosphor standard. Graticule illumination adjustable.)	3½" square, flat faced. Model CM-2 camera adapter optional, fits GA-200 Oscilloscope Camera.	5" D 5ADP7 flat-faced high persistence. Standard camera mount bezel.
Power Requirements	**External:** 95-130 v or 190-260 v, switch selectable, 50 - 1000 cps, approx. 20 watts. Terminals for operation from 12 to 28 volt DC power sources are provided. **Internal:** Snap-in battery pack module including 4 rechargeable batteries is furnished. Batteries recharge when TA-2 is plugged into AC line. Spare batteries and battery packs are available.	95-130 v or 190-260 v, 50-400 cps, approx. 35 watts.
Dimensions	9⅛" w x 12⅛" h x 18⅞" d	19" w x 7" h x 19⅛" d (slides or cabinet optional)
Auxiliary Outputs	X and Y axis plus sawtooth synch. pulse output	
Weight (Approx.)	40 pounds incl. analyzer module, battery pack module and storage compartment.	35 pounds incl. analyzer module.
Accessories (furnished) (See Page 4 for optional accessories)	Card Extender Board, Part No. 102-0001-990 Module Extender Cable, Part No. 556-161-661	

MODULES	AR-1, AL-2 SONIC	UR-3 ULTRASONIC	VR-4 VIDEO (Tentative)
Frequency Range:	20 - 35,000 cps	0.1 - 700 kc	1 kc - 27.5 mc
Center Frequency Range: Digital Readout	0 - 25 kc	0 - 500 kc	0 - 25 mc
Center Frequency Accuracy:	±1% ±50 cps	±1% ± 1 kc	±5% +5 kc
Sweep Widths: (full scale horizontal dispersion)	Preset: 0.2, 1, 5, and 20 kc linear scans, with automatic optimum resolution. Preset 25 cps to 25 kc logarithmic frequency scan on AL-2 module only. AL-2 CRT graticule has calibration for log scan frequencies.	Digital readout, adjustable 1 - 400 kc. Accuracy ±200 cps to 2 kc, ±5% over 2 kc.	Preset 25 mc. Digital readout, adjustable 50 kc to 5 mc and stabilized scan 500 cps to 50 kc. Accuracy ±10%.
Scan Linearity:	±5%		
Resolution and Skirt Selectivity:	Automatic Optimum on all scans 35 cps Resolution on 200 cps sweep width.	I-F 3 db bandwidth adjustable from 100 cps to 4 kc.	I-F 3 db bandwidth adjustable from 200 cps - 20 kc.
Minimum Frequency separation (△F) required to measure various amplitude ratios. 	△F for linear sweeps of 200 cps 1 kc 5 kc 20 kc E_1/E_1 1:1 35 cps 70 cps 120 cps 300 cps 10:1 65 cps 130 cps 240 cps 500 cps 100:1 180 cps 320 cps 500 cps 875 cps 1000:1 425 cps 700 cps 1100 cps 1500 cps	△F for 100 cps selectivity. 100 cps 300 cps 600 cps 1300 cps	
Scan Rate	1 cps (Manual Scan Optional)	Adjustable 1 - 60 cps (Manual Scan Optional)	Adjustable 1 - 60 cps plus manual scan
Amplitude Scales	Linear: Calibrated 1.0 - 0 Accuracy ±10% 40 db Log: Calibrated +20 db, 0, −20 db in 5 db increments Accuracy ±2 db	Linear: Calibrated 1.0 - 0 Accuracy ±5% 40 db Log: Calibrated 0 to −40 db in 5 db increments Accuracy ±2 db	Linear: Calibrated 1.0 - 0 Accuracy ±3% 40 db Log: Calibrated 0 to −40 db in 5 db increments Accuracy 0 to 30 db ±1 db 30 to 40 db ±2 db
Amplitude Response Uniformity: (Flatness)	±0.5 db, 20 to 25000 cps −3 db max. at 35 kc ±1 db 25 cps to 25 kc on AL-2 Log Scan.	±0.5 db, 100 cps to 500 kc	±1 db 1 kc to 25 mc
Sensitivity (Full Scale linear deflection)	30 μv Direct reading frequency selective voltmeter in volts and dbm ref: 600 ohms Accuracy ±10%	30 μv	30 μv
Attenuators	Input: 100 db in 10 db steps. Accuracy: ±0.02 db/db Smooth level control also provided I-F: 20 db in 5 db steps Accuracy ±0.02 db/db	Accuracy 0.05 db/db to 500 kc Smooth level control also provided I-F: 20 db in 5 db steps Accuracy ±0.02 db/db	RF: 70 db in 10 db steps Accuracy ±0.05 db/db I-F: 20 db in 5 db steps plus accuracy ±0.04 db/db step 10 db smooth control also provided
Input Impedance	100,000 ohms	100,000 ohms shunted by less than 40 p.f.	50 to 75 ohms, switch selectable High impedance probe optional. Probe terminals on VR-4 panel
Marker fundamental frequencies (Crystal controlled, harmonics usable throughout band	2.5 kc ±0.02%	25 kc ±0.1%	25 kc, 500 kc and 5 mc; ±0.02%
Residual Distortion	>60 db down	>60 db down	>50 db down
Video Filter Post detection, smoothing, filter.	optional	optional	Continuously adjustable time constant to >0.05 sec.
Operating Temperature Range	0° to 55° C		
Module Dimensions:	8" w x 6" h x 9½" d		
Power Requirements	All power is derived from TA-2 or RTA-5 Main Frame		
Other			Local oscillator output >0.3 volts rms on front panel. Operable with slightly modified Model G-6 Companion Sweep Generator for frequency response plotting.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

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GLOSSARY OF SPECTRUM ANALYZER TERMS

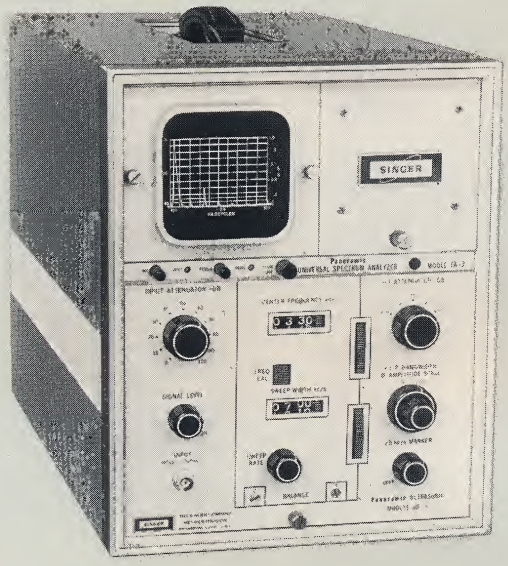

FIGURE 1A: Typical *Panoramic* Spectrum Analyzer, Model TA-2, detailing front panel controls. The solid-state portable TA-2 main frame accommodates plug in modules for the 20 cps to 27.5 mc band. Note digital readout of center frequency and sweep width.

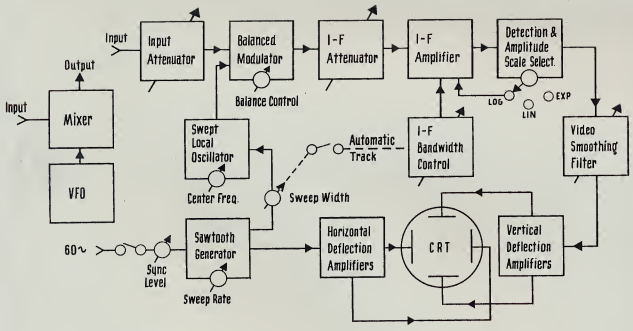

FIGURE 1B: Simplified Block Diagram of Basic Spectrum Analyzer

Spectrum Analyzer: A scanning receiver which automatically tunes through a selected spectrum and displays on a CRT or chart, a plot of level vs. frequency of signals at its input. It is an automatic Fourier Analysis plotter. See Figure 1A (typical *Panoramic* Spectrum Analyzer), Figure 1B (block diagram) and Figures 2-7 (display photos).

Log Scan: A spectrum display which has its frequency axis calibrated logarithmically. (See Figure 2)

Sweep Width: (Dispersion) (For linear scans) The spectrum segment scanned or displayed. (usually adjustable) Refers to the scan excursion over the calibrated section of frequency axis of the readout scale. (See Figure 3)

Center Frequency: (For linear scans) The frequency at the center of the spectrum display, (usually tunable). (See Figure 3)

Sweep Rate: The scan repetition rate, (usually adjustable).

Sweep Time: Reciprocal of "Sweep Rate".

Manual Scan: Adjustable fixed tuning of an analyzer which permits fixed positioning of frequency tuning of the analyzer over the selected "Sweep Width" band. The automatic scanning of the analyzer is made inoperative. "Manual Scan" enables a Spectrum Analyzer to be used as a "Wave Analyzer" with X-Y Recorder readout.

I-F Bandwidth: The effective selectivity of the analyzer filter; usually the 3 db bandwidth of the most selective I-F in the analyzer. Corresponds to "Resolution" for zero (or very low) scan - rates.

Resolution: The selectivity of an analyzer, i.e., the ability of a spectrum analyzer to display adjacent frequencies separately. Defined as frequency separation ($\triangle f$) of two equal amplitude signals, the indications of which merge at the −3 db points. (See Figure 4, also "I-F Bandwidth").

Optimum Resolution: Best obtainable resolution for a single channel swept-band analysis is limited by "Sweep Width" and "Sweep Rate". Practical limitation may be calculated by:

$$R = 1.5 \sqrt{\text{Sweep Width (cps)} \times \text{Sweep Rate (cps)}}$$

Where: R = Best Obtainable Resolution (cps)

Skirt Selectivity: Related to "Resolution", but specifically, the ability of a Spectrum Analyzer to display and measure closely spaced signals of *unequal amplitude*. Expressed in cps, values of "Skirt Selectivity" are often given for a 20, 40 and 60 db signal amplitude difference, such as 50 cps separation for a 60 db ratio. (See Figure 5)

Incidental FM: (Residual FM) The short term jitter or undesired FM deviation of a local oscillator. (Tends to limit "Resolution" when "Incidental FM" approaches "I-F Bandwidth" in magnitude.) (See Figure 6)

Minimum Useable Dispersion: The narrowest "Sweep Width" obtainable for meaningful analysis. When limited by "Residual FM" on microwave analyzers, very often defined as "10 x Residual FM".

Image Response: Response of an analyzer (or an heterodyne receiver) to a signal which is separated in frequency by twice the I-F frequency, from the frequency to which the analyzer is tuned. Images cause spurious response when the spectrum occupied by a signal is wider than twice the analyzer first IF frequency, unless there is some pre-selection.

Zero Pip (For Low Frequency Analyzers): The response of an analyzer which appears when the swept local oscillator is equal to the analyzer I-F frequency. (Corresponds to zero input frequency on the frequency axis).

Sensitivity (CW): Analyzer rating for measurement of periodic, resolved signals. For low frequency analyzers: Minimum rms level of a frequency for full scale deflection. For microwave analyzers: Minimum CW signal rated at 6 db above residual noise level; i.e., Signal plus noise deflections = twice x noise deflection. (See Figure 7)

Flatness of Response: (Sensitivity variation) (1) "In-band Flatness"; Uniformity of amplitude response over the rated maximum "Sweep Width" of an analyzer. (2) Sensitivity variation; over the entire rated frequency range.

Residual Distortion: Ratio (in db) between an input signal level and the level of *analyzer produced distortion.*

Dynamic Range: Maximum useful ratio of analyzer for measuring weak frequency components of a complex signal, i.e., the dynamic range would indicate weakest measurable harmonic of a fundamental waveform. "Dynamic Range" should not be confused with "Input Amplitude Range" which refers to range between minimum measurable signal level and maximum signal level which can be handled by the analyzer front end attenuators. Residual distortion often limits the useful dynamic range.

Discrete Signals: Periodic steady state waveforms; these have line spectra.

Line Spectrum: Spectrum of a periodic signal consists of one or more frequencies, e.g., a square wave is composed of fundamental and odd harmonic frequencies.

Random Signals: Waveforms with at least one parameter (usually level) which is a random function of time, e.g., thermal noise or shot noise.

Spectral Density: Power per cps bandwidth or volts per square root of bandwidth. The level vs. frequency of continuous spectrum distributions such as for noise and transient signals.

Noise Sensitivity: Analyzer rating which relates vertical deflection to the rms level of random signals within the scanned bandwidth. A known noise level is usually used to calibrated Noise Sensitivity, in terms of power or voltage spectral density for full scale deflection at a desired setting of IF bandwidth.

Smoothing (Video) Filter: Low pass filter is the vertical deflection circuits to smooth amplitude fluctuations in order to display the spectral density, the average level of random signals vs. frequency. The time constant is usually variable.

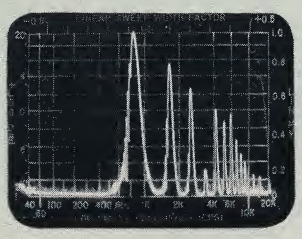

FIGURE 2

Harmonic analysis of distorted signal displayed on the LOG Frequency Scan of the *Panoramic* Sonic Analyzer, Model LP-1aZ. Note frequency calibrations (40 cps to 20 kc) along bottom of screen.

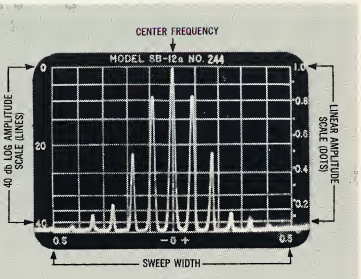

FIGURE 3

Spectrum Analyzer display of an amplitude modulated signal. Center Frequency of analyzer was tuned to the frequency of the carrier. Logarithmic amplitude scale of analyzer permits relative amplitude of side bands to be read directly in DB.

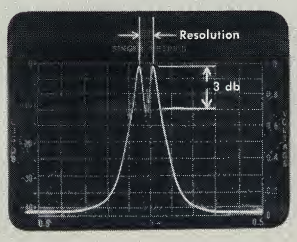

FIGURE 4

Example of Resolution

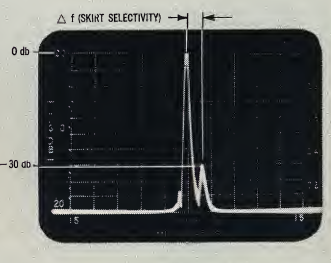

FIGURE 5

Definition of "Skirt Selectivity"

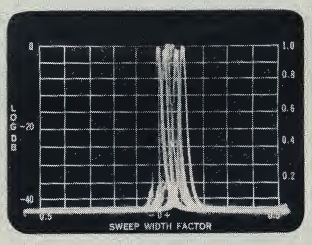

FIGURE 6

Example of excessive analyzer incidental F.M. Input is a stable CW signal.

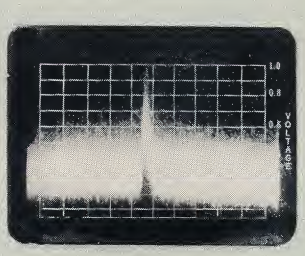

FIGURE 7

Noise limited CW SENSITIVITY Signal plus noise = twice noise (for microwave band analyzers).

This Glossary has been compiled by Edward F. Feldman, Sales Manager, *Panoramic* Instruments, The Singer Company, Metrics Division.

Mr. Feldman joined the Metrics Division in 1962 when Panoramic Electronics, Inc., the pioneer in spectrum analysis, was acquired by The Singer Company. Previously, he had been associated with Panoramic Electronics in several engineering and marketing functions.

Mr. Feldman received a MEE from The Polytechnic Institute of Brooklyn, a BSEE from The Cooper Union, and is a member of Tau Beta Pi, Sigma Xi, and Eta Kappa Nu honorary societies. He has published many technical papers and received several patents relating to instrumentation developments.

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